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POISONOUS SNAKES OF THE UNITED STATES

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Contents

	Page		Page
Introduction	1	Treatment for bites of North American poisonous snakes.	11
Key to the principal poisonous snakes of the United States.	3	Don'ts for the victim	11
Names and ranges of the rattlesnakes	5	What to do first	11
Poison apparatus of venomous snakes.	6	Other first-aid measures	11
Poison fangs	6	Additional treatment	12
Length of stroke	6	Special directions for the physician.	13
Venoms of poisonous snakes	7	Extra precautions	13
Mortality resulting from snake bite	9	Rattles	13
Snakes committing suicide	11	Young	14
		Exposure to sun	14
		Food habits	15
		Bibliography	15

INTRODUCTION

Snakes are easily confused with one another, and the question as to whether a certain one is poisonous or harmless arises again and again. Out of about 205 species and varieties of snakes that occur in the United States and Lower California, less than 15 percent can be considered dangerous to man. Poisonous snakes are provided with a specific venomous fluid and an apparatus especially adapted for the introduction of this poison into their victims. As it is usual to regard all snakes as venomous, the burden of proof is upon those believing in their innocence. So many wonderful stories concerning snakes have been current from time to time that the public in turn becomes skeptical about everything concerning snakes or firmly believes in traditional accounts that usually are highly erroneous. Allowance being made for misinterpretation of certain natural habits of reptiles, the grain of truth may be perceived in these traditions in spite of the exaggeration that ordinarily accompanies a good snake story. Nevertheless, poisonous snakes are an actual as well as a mental hazard in these days of hiking, camping, and auto picnicking.

The coral, or harlequin, snakes (Micrurus and Micruroides) are members of the cobra family (Elapidae) that have become adapted to a subterranean existence, and occur from South Carolina and Arizona to South America. They have solid, rigid fangs with a groove on the front surface and are frequently confused with the nonvenomous scarlet snake (Cemophora coccinea) and scarlet king snake (Lampropeltis elapsoides). The former differs from the harlequin snake (and also from the scarlet king snake which it resembles very closely) in having the ventral surface yellowish white; the scarlet king snake differs from the harlequin in having the black cross bands less than half the width of the crimson.

The Crotalidae, or "pit vipers", have hollow fangs that fold back against the roof of the mouth when the jaws are closed. They occur throughout Temperate and Tropical America and include a number of venomous species that are familiarly known by the following names: Rattlesnakes (Crotalus), massasauga (Sistrurus), cotton-mouth water moccasin (Agkistrodon piscivorus), and copperhead (Agkistrodon mokasen). No true vipers are found on the American continents. The well-known rattlesnakes, of which there are a number of species, are the most specialized of all the venomous snakes. The rattlesnake race has been extraordinarily adaptable, as its members have come to occupy the most diverse conditions of environment, including extremes both of humidity and aridity.

The southeastern diamondback rattlesnake (Crotalus adamanteus) is also known as the water rattler because it is partial to the neighborhood of water and is a good swimmer; yet others, the pallid rattler (Crotalus mitchellii), for example, live in typical deserts. The prairie rattler (Crotalus c. confluentus) occurs over the dryish areas of the Great Plains, while a related form, the banded rattlesnake (Crotalus horridus), is limited to the timbered areas of the eastern parts of the United States. It is certain that rattlesnakes do not habitually climb trees, because they are poorly adapted to such an accomplishment, yet there is unquestionable proof that they do so occasionally. It requires but little more climbing ability to scale a rough-barked slanting tree than the face of a rocky ledge.

The pigmy rattler and massasauga (Sistrurus) are diminutive forms of rattlesnakes (Crotalus), the largest attaining a length of nearly three feet and a thickness of less than one inch; their range is chiefly east of the Rocky Mountains, except for Arizona, and they are characteristically forms of the prairies and their swamps and marshes. The diamondback rattlers (Crotalus adamanteus and C. atrox) are unquestionably the most excitable and dangerous of all North American pit vipers. The red rattler (Crotalus exsul) is said to be the most sluggish. The cotton-mouth water moccasin frequents the lowlands along the southern rivers and the adjoining swamps into which the rivers overflow during high water; when surprised it throws its head back and opens its mouth, disclosing the white lining. In the Northern States the copperhead is partial to rocky places in the vicinity of timber, marshes, or abandoned stone quarries; in the South it frequents higher and drier ground than around the marshes; unless cornered, this snake usually attempts

to escape unseen. Nevertheless, the copperhead is a rather dangerous snake, giving no warning of its presence, and striking in any direction.

Another small group of mildly poisonous snakes is found along the Mexican border of the United States. They have grooved teeth in the rear of the upper jaw and can scarcely be considered dangerous to man. This group includes the Jews-harp snakes (Trimorphodon spp.), the annulated snake (Leptodeira septentrionalis), the black-banded snake (Coniophanes imperialis), and the Oxybelis (Oxybelis microphthalmus). A genus of diminutive snakes known as the black-headed snakes (Tantilla spp.) also belongs to this group and occurs throughout the southern half of the United States. The last-named snakes are so small and have such minute fangs that they are totally harmless to man.

Key to the Principal Poisonous Snakes of the United States

Smooth-scaled snakes, characterized by brilliant colors; markings consisting of broad alternating rings of crimson and black, separated from each other by narrower yellow rings; black bands as broad as the crimson; a pair of short, erect longitudinally grooved fangs in front of upper jaw; head as wide as neck.....Coral, or harlequin, snakes--ELAPIDAE.

Head black in front, a yellow band across center and behind this a black ring; yellow body rings very narrow. Most common in the Gulf States, but extending north to North Carolina, and in the Mississippi Valley casually northward to Indiana and Ohio .....Coral, or harlequin, snake--Micrurus fulvius.

Head black over greater portion; yellow band on back of head and behind this a red ring; yellow body rings broader. Southern New Mexico, Arizona, Tiburon Island in the Gulf of California, and northern Mexico in region bounded by Rocky Mountains and Colorado River. .....Sonoran coral snake--Micruroides euryxanthus.

Keel-scaled snakes, characterized by duller colors; markings not forming regular alternating bands, but consisting of blotches, diamonds, or incomplete bands; a pair of long, hollow, freely movable fangs that fold back against roof of mouth when jaws are closed; deep pit on face between nostril and eye; scales on upper parts keeled; pupils elliptical in shape, vertical in position; head wider than neck......"Pit vipers"--CROTALIDAE.

Tail without rattle, ending in a point; top of head covered with shields.....Agkistrodon.

Color pattern distinct; ground color pale brown (in Texas grading into pale green on tail), with large dorsal blotches of darker chestnut brown (usually in the form of a butterfly with outspread wings). Massachusetts to northern Florida, westward to Illinois, Kansas, and Texas.
.....Copperhead, highland moccasin, chunkhead, poplar leaf, or deaf adder--Agkistrodon mokasen.

Color pattern obscure; ground color light to dark brown; cross bands darker, often indistinct and bordered with yellow spots; some of ventral scales on tail undivided. Lowlands from southeastern Virginia to Florida and the Gulf States northward through the Mississippi Valley to southeastern Missouri and southern Illinois.
.....Cotton-mouth water moccasin--Agkistrodon piscivorus.

Tail with rattle.....Sistrurus and Crotalus.

A single large scale on top of head between supraocular scales (those over eyes).....Sistrurus.

Size small (adults usually less than 20 inches long); ground color grayish; large black blotches on back, smaller series on sides. Southeastern North Carolina to Florida, west through the Gulf States to western Texas and Oklahoma, and northward through Mississippi basin to Arkansas.
.....Ground rattler or pigmy rattlesnake--Sistrurus miliarius.

Size medium (adults usually 25 to 35 inches long); ground color brownish; large black blotches on back in close formation. Central New York and Pennsylvania to southeastern Minnesota and southwestward through western Texas and New Mexico to northeastern Mexico (usually in moist situations).
.....Massasauga--Sistrurus catenatus.

Many small scales on top of head between supraocular scales (those over eyes).....Crotalus.

Names and Ranges of the Rattlesnakes

All the large rattlesnakes and several of the small species belong to the genus Crotalus, of which 16 species or subspecies (including 12 that are considered specifically distinct) are recorded from the United States in the 1933 Check List of North American Reptiles, by Drs. Stejneger and Barbour. The characteristics distinguishing these closely related rattlesnakes are too technical for presentation here. The scientific and vernacular names and statement of the ranges of the 12 species follow:

Crotalus adamanteus--Diamondback rattler.
About swamps from southern North Carolina to Florida and the Keys, and westward to Louisiana and Arkansas.

Crotalus atrox--Western diamondback rattler.
Dry rocky places as well as agricultural districts from Texas and northern Mexico to Arizona; Colorado and southern California; and Lower California.

Crotalus cerastes--Horned rattlesnake, or sidewinder.
Sands of desert plains in northeastern Lower California, southern California, southwestern Utah, southern Nevada, and Arizona.

Crotalus confluentus--Prairie rattler (and other common names for more western forms).
British Columbia to Lower California and eastward through the Great Plains from southern Canada to Texas.

Crotalus exsul--Red rattlesnake.
Southwestern California, Lower California, and islands in the Gulf of California.

Crotalus horridus--Banded, or timber, rattler.
In woody and hilly districts from Maine to Georgia, westward through Louisiana to the Gulf region of Texas, and northward through the Mississippi Valley to southeastern Minnesota and adjacent Wisconsin.

Crotalus lepidus--Green rattlesnake.
Mountains from border region of western Texas to southern New Mexico, Arizona, and adjacent Mexico.

Crotalus mitchellii--Pallid, or bleached, rattler.
Arizona, Colorado Desert to southern Lower California.

Crotalus molossus--Dog-faced rattler, or black-tailed rattler.
West from southern Texas to southern Arizona, and the highlands of northern Mexico.

Crotalus tigris--Tiger rattler.
Southern California, southern Nevada, and southern Arizona.

Crotalus triseriatus--Spotted rattler.
Mountains of southern Arizona, and through the central plateau of Mexico.

Crotalus willardi--Rattler.
Santa Rita Mountain region, Arizona, and northern Mexico.

POISON APPARATUS OF VENOMOUS SNAKES

The fluid, or venom, is injected into the snake's victim by means of specialized teeth on the maxillary bone of the upper jaw, which differ from normal reptilian teeth in having a groove, or canal, from base to apex. These venom fangs in the dangerous species are large and readily observed. The canals of the fangs are fed with fluid through ducts from the poison glands. Venom does not flow freely except when the snake is actually striking, for the end of the duct, which is not in contact with the base of the fang, is normally compressed by a sheath, or fold of mucous membrane. A rattlesnake may open its mouth to the fullest extent yet may or may not erect the fangs. The snake apparently has perfect control over its fangs, raising or depressing them at will. The venom is injected by the combined action of several muscles, which open the mouth, erect the fangs, compress the poison glands, and thus force the venomous fluid through the connecting duct into and through the fangs in the brief space of time in which the snake strikes its victim.

At the end of a stroke the fangs of a poisonous snake are quickly withdrawn from the flesh; the whole action is the work of an instant. Unless the snake strikes again, the mouth closes as the fangs fold back, mechanical compression constricts the excretory duct, and pressure is relieved from the poison glands by relaxation of the enveloping muscles. A poisonous snake often miscalculates the distance of the object at which it is striking. In case the object is too close, the fangs are not fully erect when the snake strikes and hence do not penetrate. Conversely, if the thing struck at is beyond reach, the whole stroke may be completed without touching the object of attack. In this case it may happen that the venom is projected several feet, an action that has given rise to repeated accounts of our poisonous snakes spitting venom.

In human beings the bite of a venomous snake is usually followed by painful symptoms and occasionally by death. Other animals are affected in various ways. The hog, for example, has a degree of immunity from the bite of venomous snakes, because of its thick skin and protecting layer of fat.

Poison Fangs

Though the fangs of our crotaline venomous snakes are shed frequently, it cannot be said that they are shed periodically. On each side of the upper jaw there is a hollow or grooved poison fang firmly ankylosed to the maxillary bone. This pair of functional fangs is supplemented by several pairs of smaller teeth growing loosely in the flesh and buried in the soft sheath of the gum. When from any cause one of the large fangs is broken off, the reserve fang nearest to it soon moves over in its place, grows fast to the maxillary bone, and becomes the functional poison fang. In case of accident to either of the fangs in use there is always a reserve fang ready to replace it.

Length of Stroke

The idea that a venomous snake can strike its full length or even a greater distance is another popular but erroneous belief. When a snake

strikes from its usual S-shaped position, the anterior half of the body, which is thrown forward, must be free from coil. In striking, the snake simply straightens out the S-shaped curves. It does not have to be in this position to strike, for observation has shown that when irritated most of our poisonous snakes can strike for short distances from almost any position. The western diamondback rattler, when excited, frequently raises its head and the S-shaped loop 10 to 15 inches above the ground, from which position it strikes sideward and downward. When this rattler is lying coiled with its head resting on its body, it is able to strike almost vertically upward. The greatest length of stroke is about three-fourths the length of the snake, but few snakes strike more than half their length.

VENOMS OF POISONOUS SNAKES

Venom is a secretion of a supralabial gland that resembles in its development the parotid (a salivary) gland in mammals. It is composed of 50 to 70 percent proteins; the chief remaining components are water and carbohydrates, with occasional admixtures of abraded epithelial cells, or saprophytic micro-organisms, while salts such as chlorides, phosphates of calcium, magnesium, and ammonium occur in small quantities. The reaction of venom to litmus is usually acid; in some cases, neutral. The venoms of the different species of poisonous snakes differ to a greater or lesser degree, although all venoms are multiple in nature, that is, they contain several toxins that act independently of one another. Warm-blooded animals are usually more susceptible to venom than cold-blooded ones. Dried venom retains its original toxic properties in unaltered strength and quality for an indefinite period. Dr. S. Weir Mitchell found that venom kept dry for 23 years was unaltered in these respects. When fresh, the venom of a snake is a somewhat viscid fluid of yellowish color.

The effect of venom on the victim is due to the complicated action of several toxic elements, of which neurotoxins and hemorrhagins (explained later) are the most important. Neurotoxins have a destructive action upon the nervous system and play the most important part in producing the death of a victim of venom poisoning. They are present in relatively large proportions and are the chief death-dealing factors in the venom of the harlequin snakes (Micrurus and Micruroides), which belong to the cobra family (Elapidae). In contrast, rattlesnakes (Crotalus and Sistrurus) and moccasins (Agkistrodon) of the family Crotalidae produce neurotoxin in comparatively small quantities. The venom of the cotton-mouth water moccasin contains more neurotoxin than that of the rattlesnake, and consequently its paralytic effect on the respiratory center and motor nerves is stronger. This toxin not only breaks down the nuclei of the ganglion (nerve center) cells, but produces granular disintegration of the sheath (myelin) and fragmentation of the conducting portions (axis cylinder) of the nerve fibers. These neurotoxins offer a high resistance to heat and retain their toxic properties after prolonged treatment with alcohol.

The hemorrhagins constitute the chief toxic elements of rattlesnake venom and have a solvent action on the endothelial cells composing the walls of the blood and lymph vessels, particularly the smallest of them known as capillaries. One of the most alarming symptoms ensuing from the bite of a pit viper is the enormous swelling and extravasation of blood

around the wound. The blood escapes from the blood vessels through holes in the walls, for the walls of the vessels are really dissolved in places. Red blood cells as well as white escape upon dissolution of the walls of the blood vessels.

The venoms of different species of snakes dissolve the red blood cells also in a similar fashion. This cell-dissolving substance, which has a peculiarly destructive effect on red blood cells, is called hemolysin. In dogs inoculated with venom the hemoglobin contained in the red blood cells readily crystallizes. It has been found in animals dying from retention of urine, after being bitten, that the tubules of the kidneys are often completely blocked with hemoglobin crystals. The activities of the white blood cells (leucocytes) also are suspended by the action of the venom. Moreover, it has been found that venom contains elements that are agglutinating as well as dissolving for the white cells and that these are distinct from those that affect the red blood cells.

Biochemical studies have shown that snake venom possesses four distinct classes of ferment-like substances apart from the cell dissolvers (cytolysins). These are the fibrin ferment and the proteolytic, diastatic, and lipolytic enzymes. One of the most remarkable effects of both rattlesnake and mocassin bites is the loss or the reduction in ability of the blood to coagulate; it has been found that venom contains a powerful ferment that attacks the fibrin (the coagulating element) of the blood. The proteolytic enzyme of snake venom softens the muscles; the diastatic enzyme activates the inactive pancreatic juice, enabling it energetically to attack albuminoids; and the third enzyme has a feeble lipolytic (fat dissolving) action in splitting lecithin and in causing fatty degeneration in the liver.

The quantity of venom yielded at any one time by our venomous snakes varies, in general, in proportion to the size and age of the snake, the length of the period of fasting or hibernation, and certain environmental conditions. The pit vipers never inject the entire contents of their glands at a single thrust, the amount injected varying from 25 to 75 percent of the total, usually being about 50 percent.

Mitchell published the following observations on the quantity of venom yielded by four rattlesnakes:

Length, 18 inches; weight, 9-1/2 ounces; capacity of gland, 11 drops.
Length, 25 inches; weight, 18 ounces; capacity of gland, 19 drops.
Length, 49-1/2 inches; weight, 3 pounds 2 ounces; capacity of gland, 29 drops.
Length, 8-1/2 feet; ejected 1-1/2 drams of venom at single bite.

The actual quantity of venom injected into a victim depends largely on the size of the snake, the length of time during which its supply has been accumulating, the depth to which the fang is thrust into the flesh, and the location of the bite. In the majority of cases human beings recover without any treatment, because the quantity of venom injected is not a fatal dose.

Mitchell repeatedly pointed out the danger of secondary bacterial

infection in victims surviving the primary effects of snake poisoning, and W. H. Welch, in 1893, discovered that rattlesnake venom causes blood to lose its bactericidal power. Normal blood serum destroys thousands of bacteria, while venomized serum does not possess this power.

Some knowledge of the action of crotaline venoms is of greatest importance to American physicians, as 99 percent of the cases of snake bite treated in the United States are caused by pit vipers. At the present time extensive experimental use is being made of the venoms of the cobra, vipers, and crotaline snakes in the alleviation of the pain accompanying malignant growths such as cancer and in the treatment of arthritis. One of the great possibilities of the use of venoms in medicine undoubtedly lies in the ability of certain of the venoms to accelerate coagulation of haemophilic blood.

MORTALITY RESULTING FROM SNAKE BITE

The average mortality from bites of the American venomous snakes was estimated by Willson in 1908 as little more than 10 percent of those bitten, but with modern methods of treatment fatalities have been reduced to less than 4 percent. A study carried on by the Antivenin Institute of America under the direction of Afranio do Amaral (1927) has shown, however, that the danger from snake bite has been underestimated. It was found that in the course of one year (July 1926 to June 1927) in Texas something like 150 cases were reported. Of these, antivenin was given in 83 cases, with 78 recoveries and 5 deaths, the death rate being 6 percent. The death incidence was higher than would have been the case had the antivenin been administered sooner. In the remaining 67 cases, in which the antivenin was not injected, 23 died, the death rate being 34.3 percent. In the Northeastern States it has been estimated that the mortality rate, in the absence of special treatment, is 10 to 18 percent of those bitten, the increase being largely due to the copperhead. In Georgia, Florida, and Alabama the average mortality is 18 to 25 percent. In Texas, New Mexico, and Arizona the death rate is somewhat higher, no doubt because of the presence of the western diamondback rattler (Crotalus atrox), and ranges from 25 to 35 percent of those bitten. Estimates ranging from 100 to 1,500 cases in the United States each year of persons bitten by venomous snakes show the present uncertainty that exists in regard to the prevalence of accidents of this sort.

The tendency of rattlesnakes to rattle whenever disturbed and to continue the rattling as long as the disturbing influence is present also explains why victims are not more numerous. The timber rattler has been known to keep up its rattle for half an hour with but few intermittent momentary pauses. The fact that the water moccasin lives in unfrequented swamps and the harlequin snakes have burrowing habits and small-sized mouths accounts for the infrequency of bites attributed to these species.

In fatal cases the time intervening between the bite and death varies greatly. Cases terminating fatally within a few minutes do occur, though fortunately they are very rare. There is a record (Roberts) that a boy 7 years old bitten by a rattlesnake on the cheek below the eye pitched forward dead before an eye witness could reach him. A little girl 3 years

old bitten on the forehead by a large rattlesnake died within 10 minutes (Blackwood). An analysis of 50 fatal cases resulting from the bites of American venomous snakes showed that 8 persons died in less than one hour, 13 between 1 and 6 hours, 18 in 1 to 24 hours, 4 died on the second day, 4 died between the third and seventh day, 1 at the end of nine days, 1 at the end of seventeen days, and 1 after more than a month. The duration of illness following snake bite is subject to the widest variation, although in the majority of cases recovery from the constitutional disturbances is complete in two or three days, and in many cases in a few hours. Cases in which illness is prolonged are septic in character and are rarely, if ever, due to the primary action of the venom. The most important complications of snake bites are produced by the absorption of putrefactive substances (sepsis) and by acute alcoholism, resulting from mistaken treatment.

The bites of pigmy rattlers and massasaugas (Sistrurus) are practically never fatal to adults, except possibly through septic complications. These small rattlers are our least poisonous snakes, for of 20 cases on record, none ended fatally. Of 408 persons bitten by larger rattlesnakes (Crotalus), 48 died; on the other hand, of 8 persons bitten by harlequin snakes (Micrurus and Micruroides), 6 died. Of 97 cases of bites by the copperhead (Agkistrodon mokasen), 5 ended fatally, and 9 persons out of 53 bitten by the cotton-mouth water moccasin (Agkistrodon piscivorus) died. When death results from the bite of harlequin snakes (Micrurus and Micruroides), it is usually between 18 and 24 hours after the bite. Symptoms of drowsiness and general depression appear within an hour or so, but if the victim survives three or four days, the danger of death passes away.

Bites on the head and trunk are more dangerous than elsewhere, and the mortality rate for bites on the upper extremities is practically double that for the lower. From 60 to 90 percent of the total number of cases result from bites on feet or legs. The mortality in children under 10 years of age bitten by our venomous snakes is at least double that of adults.

The number of deaths each year resulting from the bites of our venomous snakes, however, indicates that these snakes are not so dangerous a pest as has often been assumed. This does not mean that one should needlessly take chances of being bitten by a rattlesnake, for the bite, when not fatal, is followed by exceedingly painful symptoms and often impairment of the part bitten. Young rattlesnakes only five or six inches long are capable of injecting venom in quantities sufficient to require treatment.

In the majority of the reported cases of persons bitten by venomous snakes, the victim was bitten on the foot or leg, indicating that a high degree of protection can be obtained by wearing high-topped shoes or heavy leggings. Quail hunters in the swamps and prairies of the South will find that the best protection is afforded by a pair of waist-high rubber wading boots with special inserted canvas shank. In most cases a pair of leather puttees worn over the leather shoes will give the necessary protection against snake bites.

SNAKES COMMITTING SUICIDE

It has been stated, and substantiated in at least one instance, that rattlesnakes are susceptible to their own poison, and that death has ensued from the effects of their self-inflicted wounds. There is a possibility, however, that in such cases the fang may have punctured the spinal cord or some vital organ, and that death, therefore, is not invariably due to the poison. Snakes are not likely to bite themselves except when severely injured or wheninfuriated and unable to wreak vengeance on the tormentor. That rattlesnakes may be killed by the bites of other poisonous species of snakes has been demonstrated by experiment with captive specimens.

TREATMENT FOR BITES OF NORTH AMERICAN POISONOUS SNAKES

The following is a combination of recommendations from publications by Drs. R. H. Hutchison and Dudley Jackson (see bibliography):

The chief precaution in case of snake bites is to prevent systemic absorption of a fatal dose of venom from the quantity contained in the tissues immediately surrounding the wound. To accomplish this, action must be prompt. Local treatment is of greatest importance, and in addition the patient should be kept as quiet as possible.

Don'ts for the Victim

Don't run or get overheated. Don't take any alcoholic stimulants. Circulation, increased by exercise or by alcohol, serves to distribute the poison much more rapidly through the body. Don't injure the tissues by injecting potassium permanganate, which is now known to be of no value as an antidote. Do not depend upon reputed snake-bite "cures" commonly used. Do not cauterize the area around the bite with burning gunpowder, strong acids, or in any other way.

What to Do First

Apply a ligature, or tourniquet, a few inches above the bite. For this purpose use a rubber garter, a piece of small rubber tubing, a handkerchief, cord, or even a shoestring, which can be tightened by inserting a stick and twisting. Do not bind the limb too tightly, but just enough to retard circulation returning through the veins toward the heart. The sole object of the tourniquet is to delay absorption of the poison into the general circulation, but if it is applied too tightly or kept on too long, gangrene is likely to set in, with resulting destruction of the flesh in the affected area. It is important, therefore, to release the tourniquet every 10 or 15 minutes for about a minute at a time.

Other First-aid Measures

Make a cross-cut incision at each fang mark. For this purpose use a sharp clean knife or razor blade and make the cut all the way through the skin, that is, about 1/4 inch deep and 1/2 inch long, preferably connecting the fang marks. Suction should then be applied to the affected spot for at least half an hour, and the more blood and lymph that can be extracted the

better. If a special suction bulb having more power than a breast pump and with a smaller mouthpiece can be obtained, it will be found highly efficient. In the absence of any such device, one may remove enough of the venom by suction with the mouth. It is best to be sure that there is no abrasion in the mouth, for the venom is effective wherever it may enter the blood stream. The principal thing to do is to use suction and remove as much of the venom and as quickly as possible. If the above procedure is followed within one hour after the bite, the chances are that no further treatment will be necessary. It is always best, of course, to seek the care of a competent physician as quickly as possible.

While the cutting advised should go through the skin, care should be taken not to cut too deeply nor to sever blood vessels of any size. If inadvertently this is done, bleeding from veins, recognized by the dark red color and steady flow, may be checked by a tourniquet placed on the far side of the cut from the heart. Bleeding from an artery is bright red and in spurts and may be controlled by placing the tourniquet between the wound and the heart. In either case a knot in the tourniquet or a solid object under it should be placed directly over the severed blood vessel.

If you have antivenin with you, read carefully the directions for preparing the syringe and making the injection. Do not allow fear or agitation to make you overlook important points. When the syringe has been made ready, proceed at once to inject the entire contents of the syringe under the skin near the bite. The tourniquet should then be released for a minute.

Additional Treatment

Additional treatment, or treatment in cases where the above methods were not used soon after the bite, preferably to be administered by a surgeon, should consist of following up the advance of the swollen area and making a double row of incisions at the very upper edges of the swollen parts. These should be about 1/8 by 1/8 inch, and a series of them should completely encircle the limb affected.

It is well to remark here that novocain can be used by even a layman without ill effect. Besides enabling the one operating to do the cutting without pain to the patient, it also serves somewhat to check the spread of the venom. It may be injected completely around the limb and is very valuable in any emergency where a considerable amount of pain is unavoidable in rendering first aid.

As the swelling advances the one administering medical aid should follow it up with the incisions, and should apply suction for a period of at least thirty minutes to every series of incisions. In case one particular region becomes more swollen than the others - a nest of incisions should be made over and around it and suction applied there. If improvement is not shown the incision treatment should be repeated every four hours and the suction kept up constantly, until relief is obtained. The punctures will continue to leak diluted venom and bloody lymph for several hours. The real danger lies in making an insufficient number of incisions rather than too many. Should there be any doubt as to the number made, one should

double the amount rather than be content with the minimum.

It is most highly advised to keep the bowels of the patient open and free, using an irrigation of salt and soda solution if necessary.

Special Directions for the Physician

If the victim has not received an injection of antivenin, it is important to inject the contents of one syringe as soon as possible. At the same time, release the tourniquet, if one has been applied.

Repeat the injections every one or two hours unless and until symptoms are markedly diminished. To hasten the absorption of the serum, intramuscular injections are advised, and, in severe cases and those seen late, intravenous injection is recommended. In small children, when intravenous injection is difficult, the antivenin may be given intraperitoneally. In shocked cases, physiological salt solution injected intravenously and blood transfusion are supplementary measures of life-saving value. For weak pulse and threatened heart failure, give caffeine or strychnine.

If incisions have been made at the site of the bite, the wounds should be irrigated with a 1 or 2 percent salt solution (not normal saline). The application of strong suction may be continued over these incisions, if the symptoms and condition of the patient indicate the necessity of pushing the treatment. Otherwise, apply a hot application of a 1:10,000 part solution of mercury bichloride or a strong magnesium sulphate solution.

Extra Precautions

It sometimes happens that after the first shock and reaction have passed, the patient will show marked improvement. Some fatalities from snake bite are plainly caused by an undue sense of security following the observation that most patients do well for the first 15 hours. Even though the general symptoms may be mild, it is important to keep the patient under close observation for at least 24 hours, and active treatment should be continued as long as the swelling is progressing. Repeat the injections of antivenin every 1 or 2 hours if the swelling is increasing. The danger is always in under-treatment rather than in over-treatment.

In treatment of snake-bite in children it is important to double the initial adult dosage. The reason for this is that a mathematical relation exists between the weight of the body and the amount of venom that it can normally neutralize and dispose of without serious injury, although the amount injected by the snake is approximately the same. The smaller and lighter the body of the victim, the less venom it can withstand, and the greater the excess of venom over the normal body resistance. Therefore, if the victim is a young child, there is much more venom requiring neutralization by the serum.

RATTLES

According to popular superstition a rattlesnake acquires a new ring on the rattle each year, and hence the number of rings composing the rattle

is supposed to indicate the age of the reptile. This notion is wholly incorrect, for the rattlesnake adds from two to four rings each year, usually, three. Under normal conditions one ring is added each time the snake sheds its skin. The young rattler is provided with a single button at birth, and within a few days it sheds its skin and commences feeding; in about two months it sheds its skin for the second time and then the first ring of the rattle is uncovered or added. This has been growing under the old skin, and its presence was apparent in the swollen appearance of the tail at the base of the original button. The last seven or eight vertebrae fuse together shortly after birth and form a composite bone known as the "shaker", and it is around this bone that each cap or ring of the rattle forms.

All our snakes shed their skin one or more times during the year. The shed skin usually comes off entire, so that from head to tail it forms but a single piece of very thin transparent material, and is generally turned inside out. That part of the skin that covers the cap on the rattlesnake's tail cannot be shed on account of its peculiar shape. At the time the skin is shed, however, it is loosened and dislodged from its place and moves backward to become an additional ring on the rattle. Thus the rattle of the rattlesnake is simply a series of shed caps or rings, held together mechanically and loosely because of their shape. The rattle seldom numbers more than ten rings because the vibration at the tip is so great that the terminal rings are soon worn down or broken off.

It has often been asserted that nature equipped the rattlesnake with this rattle to warn enemies away from its death-dealing fangs, but it is the opinion of many naturalists that the rattle is used as a call during the breeding season. The idea that the rattlesnake cannot rattle when its rattles are wet from swimming or being in wet grass or rainstorms is incorrect.

YOUNG

Early in the fall the female rattlesnake brings forth 6 to 9 young about 5 inches long, the eggs having been retained in her body until hatched. The young display all the traits of the adults, and will try to rattle and bite as soon as they are born.

The copperhead and the water moccasin give birth to young during July, the litters averaging from 7 to 9.

Unlike the pit vipers, the harlequin snake is oviparous, and deposits its eggs late in May or early in June in decaying bark or damp soil. As many as 7 eggs have been found together.

EXPOSURE TO SUN

The popular belief that rattlesnakes will die upon being exposed to strong sunlight for ten minutes has recently been partially confirmed by scientific experiment. The death of the snake is due not so much to the effect of the sun's rays as to the combination of solar heat and radiation from the rocks or sand on which the snake is lying, frequently raising the air temperature to a very high point. Such excessive temperatures quickly raise the temperatures of cold-blooded snakes even beyond the apparent maximum of 46° C. which they can tolerate.

FOOD HABITS

Examination of all accessible accounts of the food habits of the poisonous snakes indicates that rattlesnakes feed on any sort of smaller vertebrates that may come within their reach. The following items have been found upon examination of stomachs: Ground squirrels, chipmunks, pocket gophers, young prairie dogs, kangaroo rats, deer mice, meadow mice, and cottontail rabbits; various small lizards, such as Uta, Cnemidophorus, and Gerrhonotus; frogs and toads; and occasionally birds as large as quail.

The food habits of the copperhead and cotton-mouth water moccasin, judging from published accounts, are essentially like those of the rattlesnake, except that more aquatic vertebrates, such as turtles and round-tailed water rats, are available for the water moccasin.

The harlequin snake does most of its feeding at night, capturing small snakes and lizards, particularly skinks (Eumeces).

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